USING RADIO REPEATERS

Application Note **12**

With GroWeather Stations

INTRODUCTION

The GroWeather station with the GroWeatherLink Software version 1.1 allows the linking of several separate weather stations to one PC through a “point-to-multipoint” radio network. The basic operation of this network assumes that the radio at each remote site can communicate directly with the base radio.

There are situations where some (or all) of the remote sites can not communicate directly with the base radio. For example, weather stations may be located in the next valley, or the farthest stations are out of range. In these cases, a “repeater” radio can be used to extend the effective coverage of the base radio. The “repeater” radio is placed between the base radio and the remote radio and can be heard by both radios. Messages sent by the base radio that can not reach the remote are heard and rebroadcast by the repeater. The repeater will also rebroadcast messages from the remote back to the base radio.

GENERAL CONSIDERATIONS FOR RADIO NETWORKS WITH REPEATERS

The radio used as a repeater can either be a standalone radio (i.e. a dedicated repeater), or have a weather station attached, in addition to acting as a repeater for other radios. It is important to remember that both the remote radio and the repeater radio must have power at the same time for communication to take place with the base radio. We recommend running the repeater radio with AC power, or other continuous power source so that the radio can be left on 24 hours a day. At the very least, it must be on whenever any of the remote radios in its area of coverage are scheduled for operation.

The repeater radio must have line-of-sight and be within range of both the base radio and the intended remote radios. The effectively limits the antenna of the repeater to the omni-directional antenna.

Make sure that you get a manual for the radio you are using. Using repeaters in a radio network increases the complexity of the operation. The more you understand how your radios work and what their limitations are, the greater chance you have to make the project work.

USING REPEATERS WITH YDI RADIOS

- First, design your radio network. The YDI radio will allow you to use up to 7 repeaters between the base radio and the remote, but each one degrades performance of the system. The manufacturer recommends using no more than 2 repeater radios in a given path. We have only tested using 1 repeater. Each remote and repeater radio should be given a unique ID. Davis’ radio configuration program has 32 different radio identification slots available for remote and repeater radios. Repeater radios are configured in the same way as remote radios.

Note: If you are planning to use only 1 weather station, but require a repeater to talk to it, you must configure the radios as “point-to-multipoint” radios, not as “point-to-point” radios with the configuration program.

- Second, install your radios and weather stations.

- Third, test the installation of the remote radios and their connection to the repeater radio. Take the base radio and a laptop computer with the GroWeatherLink software installed to the site to the repeater radio. Use the laptop computer to connect to each of the remote stations to verify that the signal from the remote reaches the repeater radio.

- Fourth, test the installation of the repeater radio. Install the repeater radio at the repeater site, and attach a weather station, even if the radio will be used as a stand-alone repeater. Install the base radio and use the GroWeatherLink software to connect to the station attached to the repeater radio. If your network uses more than one repeater, repeat steps three and four for each repeater radio.

- Fifth, configure the GroWeatherLink software to talk to the remote stations using the repeater. For each weather station that requires the use of a repeater, you will have to manually specify the connection address. In the Serial Port Settings dialog, select “Other” as the “Radio Name”. (Also select YDI Model 910 Multi-Point” as the connection type.) You will then enter the connection string in the “Phone” field in the “Modem Settings” part of the dialog. The basic form of the connection string is: <remote ID> “via” <repeater1 ID>”,”<repeater2 ID>.

The radio IDs are of the form “REM”<2 digit remote number>, where remote number is the number used in the radio configuration program. For example, if the weather station is located at “Remote 6” and the repeater is” Remote 11”, then the connect string will be “REM06 via REM11”.

USING REPEATERS WITH NEULINK RADIOS

In order to use the repeater functionality built into the RF Neulink radios, you will have to carefully consider the design of your radio network and manually configure the radios. This note will explain the important considerations, but Davis Instruments does not provide support for this feature of the RF Neulink radios.

According to the RF Neulink Operator Manual:

> **2.4 Store and Forward Repeating**
>
> The NEULINK 9600 may be configured to automatically repeat packets of data. This feature is typically used to fill in areas of coverage where a base station cannot get far enough to talk to a particular unit. It is not intended as a wide-area networking feature….
>
> Each unit may be programmed with up to four different repeat TOIDs … stored in four REPEAT registers. …
>
> When repeating is enabled the unit will watch the air for packets with a TOID matching any of the four REPEAT registers. If it sees an ID match…it will automatically transmit the received packet again. …
>
> The Ids that the unit is programmed to repeat may be individual Ids, groups, or all Ids. …
>
> Some important notes concerning the repeater function are; … the automatic ACK feature of the RDXP [Radio Data Exchange Protocol] protocol will not work in the repeat mode. If ACK is enabled [which it is for the standard Davis configuration] then the repeat function should not be used.
>
> **4.7 Repeater Feature**
>
> … [The radio] will retransmit the packet when the carrier is not busy and it is not busy sending its own data. The unit can only store one packet at a time. The repeater does not check the air for activity before it repeats a packet. …Do not program two units to repeat the same Ids on the same frequency, as they will tend to transmit at the same time, causing neither transmission to be heard by others.

These instructions impose the following restrictions on the design of a GroWeather radio network using RF Neulink repeaters:

- Only one radio can be a repeater radio. This is because one of the Ids the repeater will repeat is the base radio’s ID because we require 2-way communication. We cannot have two repeaters repeating the same ID, and thus we cannot have two repeaters.
- The automatic packet acknowledgement feature of the radios must be disabled, which can seriously degrade the overall performance and reliability of the radio network. Normally, the radios will acknowledge the receipt of each data packet, or by not acknowledging request retransmission of the packet. This happens transparently to the weather station and software on either end. Without packet acknowledgement, only “end-to-end” error checking is available to catch transmission errors. This also means that “Wireless Ready” (Rev E) WeatherLinks are REQUIRED for networks with repeaters (instead of being recommended).
- To minimize the amount of extra radio traffic, the repeater ideally would repeat only packets intended for stations that cannot be reached directly from the base radio. If the REPEAT registers are programmed with individual radio Ids, then only 3 stations (plus the base radio) can be the recipients of repeated packets. The radio ID numbers used by the Davis Radio Configuration program (0-32) all fall in the

same “group”, so any use of the group Ids with the standard ID configurations will result in the repeater repeating ALL data packets. If more than 3 radios are to be reached by the repeater, you will have to create new groups by using other IDs.

SAMPLE NETWORK CONFIGURATIONS

The following examples show how to configure RF Neulink radios for several sample network situations.

ONE TO THREE REMOTES WITH REPEATER

This configuration has between one and three remote stations and one repeater.

- First, use the wireless configuration program to configure the radios: base, remote, and repeater.
- Second, use a terminal emulation program, e.g. Windows HyperTerminal or ProComm, to modify the programming on each of the radios.
  - For the base and remote radios (but not the repeater), give the commands “ACK OFF” to turn off the automatic ACK feature, and “EXIT” to save the changes.
  - For the repeater radio, give the commands “ACK OFF”, “REPEAT 1 0000”, “REPEAT 2 <remote ID>”, (and if there is more than one remote radio “REPEAT 3 <remote 2 ID>”, “REPEAT 4<remote 3 ID>”), “PROG 0E 1” to activate the repeater function, and “EXIT” to save changes.
- Third, install the radios and weather stations.
- Fourth, when configuring the communications for the remote stations, use the same “Radio Name” as the remote radio was configured with.

MORE THAN THREE REMOTES WITH REPEATER, REPEAT EVERYTHING

This configuration can have up to 31 remote stations if you restrict yourself to the radio IDs used by the configuration program.

- First, use the wireless configuration program to configure the radios: base, remote, and repeater radios.
- Second, use a terminal emulation program, for example Windows HyperTerminal or ProComm, to modify the programming on each of the radios. For the base radio and remote radios (not the repeater), give the commands "ACK OFF" to turn off the automatic ACK feature, and "EXIT" to save the changes. For the Repeater radio give the commands: "ACK OFF", "REPEAT 1 FFFF", and "EXIT" to save changes.
- Third, install the radios and weather stations.
- Fourth, when configuring the communications for the remote stations, use the same "Radio Name" as the remote radio was configured with.

MORE THAN THREE REMOTES WITH REPEATER, REPEAT ONLY THE REMOTE RADIOS

This configuration can have as many remote radios as you want, and only those radios that require a repeater will have their packets repeated.

- First, use the wireless configuration program to configure the radios: base, remote, and repeater radios. For simplicity, assign all the remote radios that require the repeater to the same remote ID. We will be changing the ID in step 2.
- Second, use a terminal emulation program, for example Windows HyperTerminal or ProComm, to modify the programming on each of the radios. For the base radio give the commands "ACK OFF" to turn off the automatic ACK feature, and "EXIT" to save the changes.
    - For the remote radios (not the repeater), you will assign a new ID number. This number will be in a different "group" from the IDs used by the non-repeated radios. These ID's are 128 (0100 hex) through 254 (01FE hex). For each remote radio give the commands "ACK OFF" to turn off the automatic ACK feature, "MYID <new ID in hex>"and "EXIT" to save the changes.
    - For the Repeater radio give the commands: "ACK OFF", "REPEAT 1 0000" to repeat base radio packets, "REPEAT 2 01FF" to repeat packets for the new group, and "EXIT" to save changes.
- Third, install the radios and weather stations
- Fourth, when configuring the communications for the remote stations that require the repeater, use the Radio Name "Other" and enter the ID number of the remote station in the "Phone" text box. Use the prefix "0x" if the number is entered in hexadecimal.

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